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PETERBOROUGH DEMONSTRATION PROJECT:
COLLECTION OF PLASTIC FILM IN THE BLUE BOX

EXECUTIVE SUMMARY

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Report prepared for:

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DISCLAIMER

The statements, opinions, summaries and conclusions expressed in this Demonstration Project report are those of the Project Steering Committee, comprised of Proctor & Redfern Limited (Consulting Engineers, Architects, Scientists and Planners) and selected individuals from the Environment & Plastics Institute of Canada (EPIC), Ontario Ministry of the Environment (MOE) and the City of Peterborough. The statements and opinions do not necessarily represent those of the full membership of EPIC or the Ministry of the Environment.

Mention of products, technologies, and private firms in this study should not be construed as an actual or implied endorsement or recommendations for use.

FORWARD

Developing the Demonstration Project

In 1989, the Recycling Sub-Committee of the Environment and Plastics Institute of Canada (EPIC) established a demonstration framework to investigate the curbside collection of plastic film.

In February of 1990, the EPIC Recycling Sub-Committee approached Proctor & Redfern Limited (Consulting Engineers, Architects, Scientists and Planners) to assist in the development of the demonstration program and to carry out demonstration activities. The Ontario Ministry of the Environment (MOE) was approached by EPIC to co-sponsor the plastic film demonstration project.

The main objective of the demonstration project was to collect detailed information on the feasibility of adding plastic film to the list of recyclable materials collected at the curb in an established blue box program. EPIC and MOE determined that detailed information was required in the following general areas:

- quantity of plastic film that could be collected,
- collection techniques,
- participation rates,
- capture rates,
- an assessment of the material quality,
- logistics of sorting the plastic film from other recyclable materials,
- ability to market the recovered plastic film including an understanding of the logistics of baling the material, shipping, and processing into feedstock for use in a marketable product.

The data collected in a Demonstration Project will be used to assist other municipalities in determining the requirements to add plastic film to their mix of recyclable materials.

Obtaining the Final Report

A complete copy of the final report of the Peterborough Demonstration Project: Collection of Plastic Film in the Blue Box can be obtained by calling or writing to the Ontario Ministry of the Environment at:

Ontario Ministry of the Environment
Public Information Centre
2 St. Clair Avenue West
Toronto, Ontario
M4V 1L5
(416) 323-4321

Additional project details can also be obtained by calling or writing the Environment & Plastics Institute of Canada at:

Environment & Plastics Institute of Canada
1262 Don Mills Road, Unit 104
Don Mills, Ontario
M3B 2W7
(416) 449-3444

Project Steering Committee

The following people formed the Project Steering Committee and were responsible for the establishment and design of the Demonstration Project in Peterborough, data collection during the 28 week demonstration period, report writing and review:

Mike Hyde	EPIC Recycling Sub-Committee
Dave Climenhage	EPIC Recycling Sub-Committee
Dave Birkby	EPIC Recycling Sub-Committee (Chairman)
Fred Edgecombe	EPIC (Executive Director)
Rick Warner	MOE
Jane Lister	MOE
Ivan Bateman	City of Peterborough
Jay Stanford	Proctor & Redfern Limited
Patty Quackenbush	Proctor & Redfern Limited
Peter Gwyn	Proctor & Redfern Limited

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EPIC: Fred Edgecombe, Bob Hamp and the members of the EPIC Recycling Sub-Committee
MOE: Rick Warner, Jane Lister, Brendan Killackey
Du Pont Canada Inc.: David Climenhage, Dick Oughten, Rob Kearns
Dow Chemical Canada Inc.: Mike Hyde, Bruno Gaeckel
Plax Inc.: David Birkby
Novacor Chemicals Ltd.: Nolan Edmunds, Mike Koyich
Resource Plastics Inc.: Barry Woods
Tetra Pak Inc.: Abe Kabayama
City of Peterborough: Ivan Bateman
Scott's Plains Recycling Inc.: Bill Thomas, Ray Hallock and the recycling staff
Ottonabee Valley and King George Public Schools: staff and students

EXECUTIVE SUMMARY

Purpose of this Report

The purpose of this report is to provide a description of the methodology undertaken and results obtained from a demonstration project to collect plastic film in the blue box. The findings presented in this report will be of interest to municipalities currently involved in or investigating curbside source separation programs for recyclable materials, private sector companies engaged in the collection, sorting, and processing of plastic film into a marketable feedstock, private sector firms that are capable of using post consumer polyethylene pellets as feedstock in their manufacturing process and public interest groups.

Study Objective

The objective of the demonstration project was to determine the feasibility of collecting plastic films in an Ontario blue box program.

Background Information

Plastic film has only recently become a target blue box material. It has been collected by numerous blue box programs in Ontario because it is seen as an appropriate method of placing newspapers at the curb. To date, very little has been done regarding collection of plastic film.

Plastic film discarded by households represents approximately 45% (by weight) of the plastic packaging waste stream and approximately 1.5% (by weight) of the residential waste stream. The largest portion of plastic film discarded is low density polyethylene (LDPE) such as grocery sacks, milk pouches and outer bags, bread bags and produce bags. In addition, high density polyethylene (HDPE), polypropylene (PP), polyvinyl chloride (PVC) and polyvinylidene chloride (PVDC) also are used in packaging applications that are discarded. These materials represent a relatively uncontaminated stream of pure resins that can be recycled with existing technology, if it is first feasible to collect them in a blue box collection program.

Study Area Description

The City of Peterborough was chosen to host the Plastic Film Demonstration Project because of its well-established and successful blue box program. The City's blue box collection program currently serves single family households and includes newspaper, steel cans, aluminum cans, glass containers and PET 2 litre soft drink bottles.

The study area consists of two separate collection routes, Test Area A with 1,578 households and Test Area B with 1,372 households. The two collection routes were chosen in consultation with Peterborough officials for the following reasons:

- both routes were representative of the City's mix of income groups, mainly middle income with small numbers of high and low income housing types, and
- both routes were serviced by the same driver and vehicle, with Test Area A collection on Wednesday and Test Area B collection on Friday.

The sorting and baling of the plastic film was conducted at the Scott's Plains Recycling Facility.

Public Education and Promotion

Three weeks prior to commencement of the 28 week collection period, householder information kits were hand delivered to each of the households in the test areas. Throughout the demonstration project, three project updates were hand-delivered to the households in the test areas. Each was designed to provide information on the progress of the demonstration project, as well as to instruct the householders about any changes in the demonstration project at various stages.

A telephone survey was conducted during the last few weeks of the demonstration project. The objectives of the telephone survey were as follows:

- to evaluate the effectiveness of the public relations program including the information kits and project updates,

- to determine the residents' perceptions and attitudes towards the pilot project and blue box collection in general,
- to determine the success of the project from the public viewpoint, and
- to identify any problems or areas requiring further study.

Questionnaire results indicate that the public information program was informative and useful overall. However, differences were noted between Type I and Type II participants*. More than 97% of Type I participants in both test areas found the information informative and useful, although this percentage dropped substantially for Type II participants in both areas. Only a small percentage of the respondents in both test areas and in both participation types would have liked additional project information. This response was not consistent with the previous response for Type II participants.

The fridge magnet which identified the requested plastic films in either test area was a popular component of the information kit as over 80% of the Type I participants in both test areas were still using it at the end of the demonstration project. Almost all of the Type II participants were found to have discarded their fridge magnets.

Strong conclusions can not be drawn as to why different responses were found between the two participant groups. However, consistent responses were found between the same participant types.

Results of Demonstration Project Activities

Description and Assessment of Material Collected

The list of acceptable film types differed for the two test areas. Test Area A included all household plastic films. Test Area B was restricted to polyethylene films, LDPE and HDPE such as grocery sacks and shopping bags.

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*(Note: a Type I Participant is defined as a household with extra or additional plastic film in their blue box. A Type II Participant is defined as a household with plastic film in their blue box only used as packaging for the newspaper, such as a grocery sack. These classifications were derived during the four week participation analysis study.)

Test Area A:

- LDPE; e.g., grocery sacks, milk pouches,
- HDPE; e.g., some shopping bags,
- laminates; e.g., chip bags, candy bags,
- PP)/PVC/PVDC; e.g. food stretch wraps, and
- other films (not easily identified).

Test Area B:

- LDPE, and
- HDPE.

Quantity

The average weekly quantities of plastic film recovered (including contamination) in each of the test areas were:

- Test Area A - 48.0 grams/Hh/week (2.50 kg/Hh/year)
- Test Area B - 42.5 grams/Hh/week (2.21 kg/Hh/year)

The average weekly quantities recovered of requested plastic film materials (as requested in the project information kit) were:

- Test Area A - 45.3 grams/Hh/week (2.36 kg/Hh/year)
- Test Area B - 40.6 grams/Hh/week (2.11 kg/Hh/year)

Composition

Comparison of quantities of plastic film types collected per household per week in each test area indicate that there is little difference in the quantities collected of LDPE and HDPE between the two test areas:

- Test Area A - 40.9 grams LDPE/Hh/week (2.13 kg/Hh/year)
  - 2.2 grams HDPE/Hh/week (0.11 kg/Hh/year)

- Test Area B - 39.1 grams LDPE/Hh/week (2.03 kg/Hh/year)
  - 1.5 grams HDPE/Hh/week (0.08 kg/Hh/week)

In Test Area A, the sum of laminates, PP/PVC/PVDC and other film categories made up less than 5% of the total weight collected (5.2% of the acceptable plastic film material). In Test Area B, where these plastic film types were not requested, the sum of other plastic films made up 2% of the total weight collected.

Participation Analysis

The purpose of the participation analysis was to determine the percentage of households that placed plastic film in their blue box relative to the total number of households served by the blue box program in the test areas. A "participating household" is defined as a household that sets out a blue box containing flexible plastic film at a minimum frequency of once every four weeks.

A classification of all test area households with respect to blue box recycling and the demonstration project is shown on Figures 1 and 2. The classifications outlined are as follows:

- Blue Box participant - a household that places a blue box at the curb at least once in four weeks,
- Demonstration Project participant - a household that places a blue box with plastic film at the curb at least once in four weeks,
- Type I participant - a demonstration project participant identified as placing additional plastic film in their blue box, and
- Type II participant - a demonstration project participant identified as placing only plastic bags with ONP in their blue box.

Results indicate that of those households already participating in the blue box program (78% in Test Area A and 76% in Test Area B), over 90% placed plastic film in their box during the demonstration project, and of these, 64% to 77% took the extra effort to separate additional plastic film from their waste stream at the minimum frequency level or better. In summary, the following program participation was determined for those households participating in the blue box program in each test area:

Figure 1

Summary of Participation Study
Study Area "A"

PARTICIPATION IN BLUE BOX PROGRAM (four week period only)	No. of Homes	Percent of Study Area
Did Not Participate	346	21.9%
Set Out Blue Box Once In 4 Weeks	324	20.5%
Set Out Blue Box Twice In 4 Weeks	311	19.7%
Set Out Blue Box Three Times In 4 Weeks	303	19.2%
Set Out Blue Box Four Times in 4 Weeks	294	18.6%
TOTAL BLUE BOX PARTICIPATION DURING 4 WEEKS	1232	78.1%
TOTAL HOUSEHOLDS	1578	100.0%

PILOT PROGRAM	No. of Homes	Percent of Study Area
Did Not Include Film	449	28.5%
Included Film Once in 4 Weeks	367	23.3%
Included Film Twice in 4 Weeks	305	19.3%
Included Film Three Times in 4 Weeks	256	16.2%
Included Film Four Times in 4 Weeks	201	12.7%
INCLUDED FILM AT LEAST ONCE IN 4 WEEKS	1129	71.5%
TOTAL HOUSEHOLDS	1578	100.0%

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Figure 2

Summary of Pariticipation Study
Study Area "B"

PARTICIPATION IN BLUE BOX PROGRAM (four week period only)	No. of Homes	Percent of Study Area
Did Not Participate	325	23.7%
Set Out Blue Box Once in 4 Weeks	259	18.9%
Set Out Blue Box Twice in 4 Weeks	300	21.9%
Set Out Blue Box Three Times in 4 Weeks	241	17.6%
Set Out Blue Box Four Times in 4 Weeks	247	18.0%
TOTAL BLUE BOX PARTICIPATION DURING 4 WEEKS	1047	76.3%
TOTAL HOUSEHOLDS	1372	100.0%

PILOT PROGRAM	No. of Homes	Percent of Study Area
Did Not Include Film	395	28.8%
Included Film Once in 4 Weeks	287	20.9%
Included Film Twice in 4 Weeks	299	21.8%
Included Film Three Times in 4 Weeks	227	16.5%
Included Film Four Times in 4 Weeks	164	12.0%
INCLUDED FILM AT LEAST ONCE IN 4 WEEKS	977	71.2%
TOTAL HOUSEHOLDS	1372	100.0%

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	A	B
■ Blue box participation	100.0%	100.0%
■ Demonstration project participation	91.5%	93.3%
■ Type I participation	58.0%	71.8%

When all households that have access to blue box collection are included in the analysis, all participation rates are lowered as follows:

	A	B
■ Total test area households	100.0%	100.0%
■ Blue box participation	78.1%	76.3%
■ Demonstration project participation	71.5%	71.2%
■ Type I participation	45.8%	54.8%

Capture Rate Analysis

The purpose of the capture rate analysis ('snapshot') was to determine the quantities of plastic film resin types that are collected in the blue box of a participating household in relation to the quantities generated in that household.

Results indicate that the capture rate for LDPE and HDPE type films are higher than for laminates, PP/PVC/PVDC, and other films. Separate results are shown for the two participation classifications:

Test Area A:	Type I Participants -	48.5%
	Type II Participants -	3.8%
Test Area B:	Type I Participants -	46.4%
	Type II Participants -	4.8%

The results of the calculation of quantity captured and capture rates for Types I and II participants in Test Areas A and B are presented as follows:

Test Area A:

Type I participant quantity captured = 4.873 kg/Hh/year
capture rate = 4.873/14.0
= 34.8%

Test Area B:

Type I participant quantity captured = 3.717 kg/Hh/year
capture rate = 3.717/8.4
= 44.3%

As was observed during the demonstration project, reuse rates (e.g. grocery sack used as a waste basket liner) ranged from 10% to 20% across the test areas and participation types. Therefore, the combined capture and reuse rates for Type I participating households are:

- Test Area A: 35% capture + 10% to 20% reuse = 45% to 55%, and

- Test Area B: 44% capture + 10% to 20% reuse = 54% to 64%.

Material Quality Analysis

The purpose of analyzing material quality was to determine the levels of non-requested materials and contamination in the collected plastic film. Non-requested materials are those materials excluded from the collection program as outlined in the initial information kit. The quantity of non-requested materials present in the collected plastic film are indicative of the amount of sorting required at the MRF.

The average percentage of 'non-requested' materials in Test Area A was 5.6% by weight while in Test Area B it was 4.5% by weight. 'Other materials' made up a larger percentage of material collected in Test Area A than B (4.7% in A compared to 2.2% in B). This difference could be attributed to the greater number of materials and plastic film types allowed in Test Area A. This may have caused the householder to practice less discretion about the materials placed into the Blue

Box. Test Area B plastic films consisted primarily of grocery sacks and shopping bags, which are easily identified and generally require less effort to clean and source separate. (Note: it is not possible to estimate the percentage of non-requested materials that were directly the result of the addition of plastic film because non-requested materials were arriving in the ONP compartment prior to the demonstration project.)

The total residue contamination remaining in the material collected in both test areas is approximately 0.6%, which is not significant in terms of processing requirements.

Conveyor Belt Sorting Analysis

The householders were instructed to 'stuff' the plastic film into the same bag alongside the newspaper or in a separate plastic bag. The driver of the collection vehicle placed the plastic film into the same compartment as the newspaper and therefore no sorting at curbside was required. A plastic bag containing other plastic films would require only one additional toss onto the collection vehicle. Observations of collection early in the demonstration project and discussions with the driver responsible for the test area collection routes indicated that there was not a measurable increase in time to collect the test area plastic film at the curb. Since the newspaper compressed the film in the ONP compartment, no problems were encountered with the compartment filling up or "cubing out".

Therefore, the incremental time required to collect and sort film is accounted for primarily at the MRF following delivery of the materials. This time was measured through the conveyor belt sorting analysis.

The purpose of the conveyor belt sorting analysis was to determine the incremental increase in time required to sort the test area plastic film from the newspaper compared to the base case. The base case is defined as the time to sort the existing plastic film arriving in loads of newspaper from non-test areas.

On average for this study, it was found that there was an approximate increase of 85% in the time required to sort one kilogram of ONP in the base material to the time to sort one kilogram of ONP in the test area material. However, it should be realized that for each kilogram of ONP sorted there was 6.5 times more plastic film sorted in the test area material than the base case material.

Calculations are presented which express the results in terms of staff hours required to sort one tonne of test area material as well as the incremental time to sort one tonne of plastic film. The municipality may apply local value for labour efficiency and employee wages to these staff hour/tonne estimates to calculate an average cost relative to one tonne of ONP.

A sample calculation has been done by applying estimated costs to a city of equivalent size to Peterborough (assuming: 80% labour efficiency; $10 per staff hour). The results indicate that the annual incremental cost attributed to the city would be an estimated $12,000. Application of this cost to all city households results in a cost of $0.57 per household per year (or an incremental cost of $245/tonne for incremental tonne of plastic film).

Marketing Plastic Film

A total of three bales were prepared from plastic film collected during the demonstration project:

- Bale #1 contained only pre-sorted LDPE and HDPE collected over a 12 week period from Test Area A,
- Bale #2 contained all plastic films, except contaminants, collected during a 12 week period from Test Area B households, and
- Bale #3 contained all material, except contaminants, collected during a 9 week period from Test Area A households.

All bales were placed on a regular transport trailer using a forklift. No special requirements were needed at the MRF, on the vehicle or at the plastic processing centre. The three bales were shipped to Resource Plastics Corporation in Brantford, Ontario. Bales #1 and #2 have been processed. To date, about half of Bale #3 has been processed. The remaining portion of Bale #3 will be processed after some modifications are made to the facility. The material from the demonstration project passed through the following basic process steps: shredding, washing, separating, drying and pelletizing.

All processed LDPE pellets from Bales #1 and #2 were placed into large storage containers, labeled, and shipped to research laboratories at Du Pont Canada Inc. and Novacor Chemicals Ltd. for analysis. Half of Bale #3 is currently being analyzed at Dow Chemical Canada Inc.

The first two bales were successfully processed into LDPE pellets. Only minor problems were encountered during the recycling process (e.g. pellet cracking due to gases associated with the inks, etc.). Further difficulties were encountered when processing Bale #3. Independent investigations are currently under way to isolate the problem areas and determine probable causes. For further information regarding the pellet analysis results, the reader is asked to send a written request to EPIC. A technical report summarizing this information will be available from EPIC at a later date.

Converting LDPE Film Pellets into Marketable End Products

One of the most significant findings of the demonstration project has been the demonstration that mixed plastic (polyethylene) film collected from curbside in Test Area B can be processed back to film quality pellets in the process used by Resource Plastics (Note: based on the composition of plastic films collected in Peterborough, the pellets that were processed at Resource Plastics are referred to as LDPE pellets).

Plastic films under 1 mil (0.001 inches) thickness were manufactured with 50% recycled content. Also demonstrated was the manufacture of 1.5 to 2 mil films with 100% recycled content. This result should be qualified by the fact that the runs were relatively short and this will not necessarily represent the level of recycled content that can be achieved on all plastic extrusion lines. However, it is clear that a significant level of LDPE can be added to a number of existing polyethylene films. As a result, the recycled resin will have access to a very large existing market and can replace virgin resin sales in a number of end uses. This should provide more than adequate markets for the blue box plastic films collected in Ontario and other provinces in Canada as programs are established.